

Chapter 1

Overview of ADX

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Chapter 1

Overview of ADX

The ADX Interface

Welcome to the SAS ADX Interface for Design of Experiments. The ADX Interface features powerful but intuitive tools for designing and analyzing experiments.

Using This Book

Getting Started with the SAS ADX Interface for Design of Experiments is intended to help you quickly learn the primary features of the ADX Interface. This tutorial takes you through the steps of creating and analyzing the various types of experimental designs offered by ADX.

This book is not intended as comprehensive documentation, nor should it be considered as an experimental design text. However, the Appendices provide a glossary of terms and a list of references you may find useful.

You should have some understanding of design of experiments and be familiar with such terms as factorial screening design and normal plots. Of course, ADX provides some new and exciting ways to analyze your experimental designs.

Chapter Topics

In this chapter, you get acquainted with the ADX environment by working through a simple example.

Covered in This Chapter

- Creating a new two-level design
- Selecting a design
- Editing responses
- Exploring data
- Using a main effects plot
- Using a cube plot
- Using ADX Help

Task List

- Get acquainted with the ADX desktop.
- Learn how ADX organizes designs.
- Learn how designs achieve particular experimental objectives.
- Create a simple two-level factorial design.

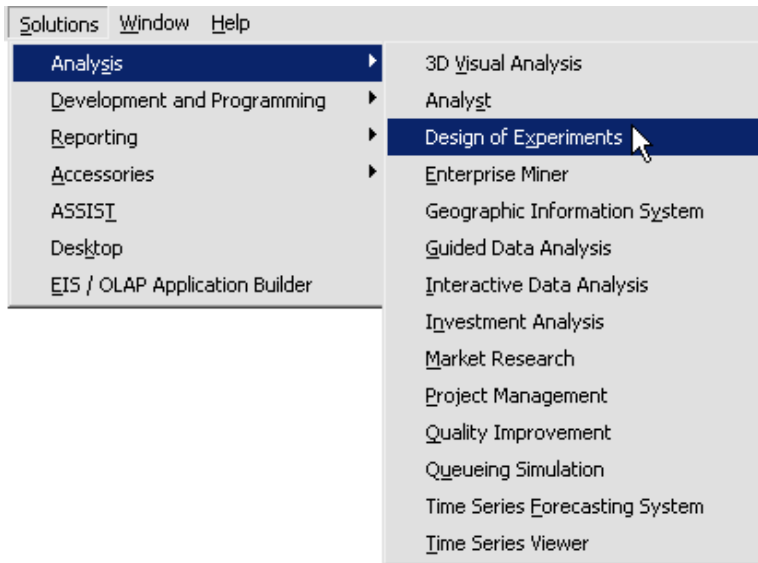
Your First ADX Session

You do not need to know SAS programming to get started with ADX. The organization of the ADX Interface guides you step-by-step through the process of constructing a design, analyzing the data, and creating a report.

ADX provides menus and tool buttons for performing each task in this process. The menus change depending on the ADX window that is open on the desktop.

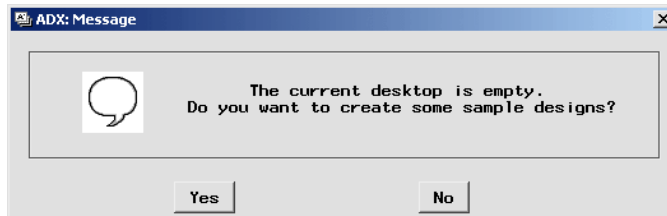
Starting ADX

To access ADX, first access the SAS System from your desktop. Then select **Solutions** → **Analysis** → **Design of Experiments** from the pull-down menu in the SAS windowing environment.



Initial ADX Call

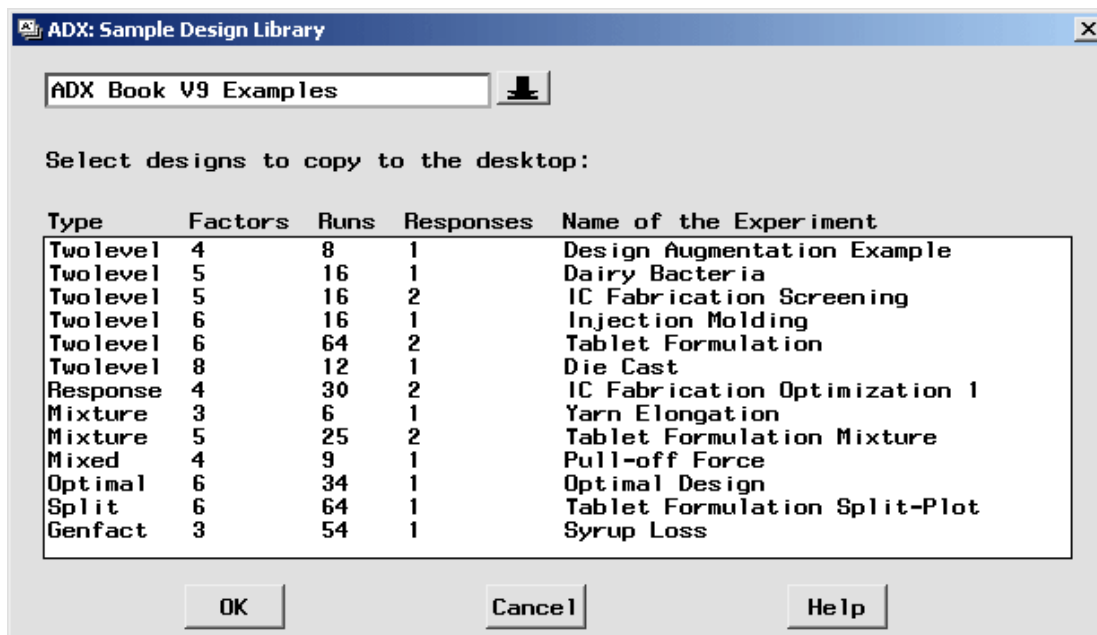
If this is the first time ADX is called, you will see this Message window.



Follow these steps:

1. Click **Yes**. In the next window you select the sample designs to put on the ADX desktop.

2. To create the designs used in this book, click **ADX Book V9 Examples** and Shift-click to select all the designs.



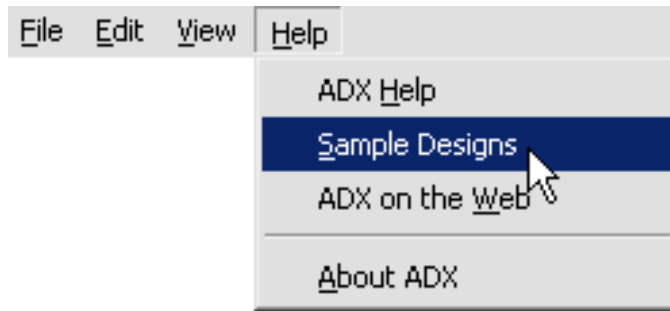
3. Click **OK**. Once ADX creates the sample designs, it puts them into the ADXPARM folder.

Adding Sample Designs to the Desktop Folder

If you are accessing ADX subsequent to an initial call, you want to add the sample designs to the current folder. (Your folder of sample designs may have different designs, depending on which sample designs were selected during the initial ADX call.)

To add sample designs to the current folder, follow these steps:

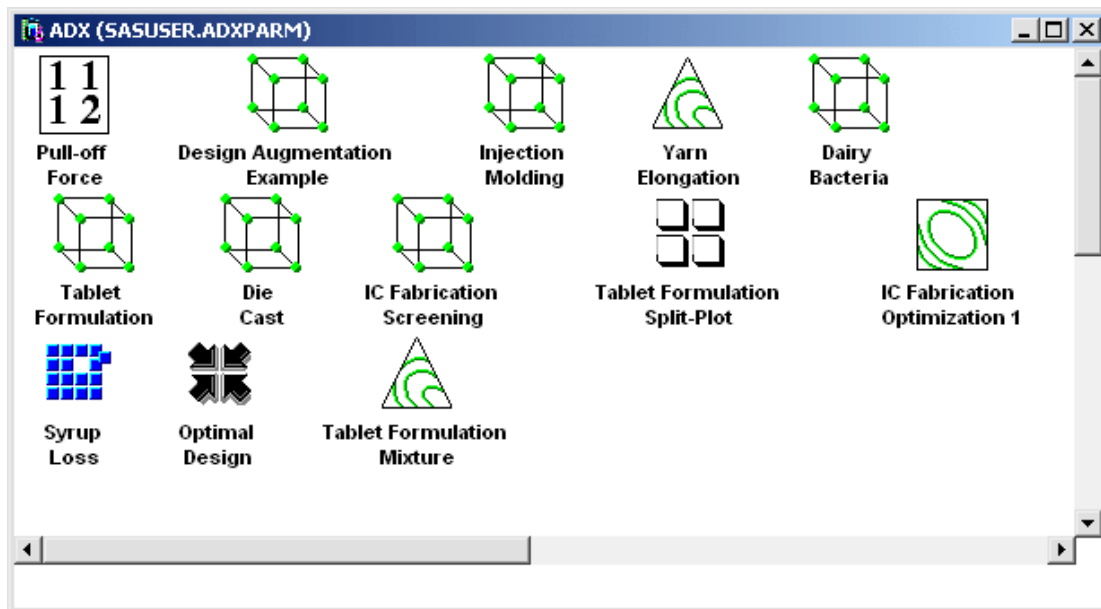
1. Select **Help** → **Sample Designs**.




2. ADX instructs you to select the designs you want to copy.
3. Click **ADX Book V9 Examples**.
4. Select all the designs (Shift- or Control-click to select multiple designs).

Managing Your Designs with the ADX Desktop

The ADX desktop is the starting point for working with designs. From the desktop, you can access folders of designs, each of which appears in a separate window. Within each folder, designs are organized by type. Each design type has its own icon.



The name of the default folder is ADXPARM. Use the commands in the **File** menu or the folder icons  on the toolbar to create new folders or to change the current folder. If you create a new design, it will be added to the current folder.

See [Chapter 13](#) for more information on organizing your designs.

Design of Experiments Process

Design of experiments is a process in which designing the experiment is only one step. For any experiment, follow these steps:

1. Determine the experimental objective.
2. Determine the factors and responses.
3. Design the experiment to meet the objective.
4. Collect the data.

5. Analyze the data with graphs, plots, and statistics.
6. Report the experimental results.
7. Design a new experiment.

Design Objectives

Designs offered by ADX can be used to achieve specific experimental objectives as shown in Table 1.1:

Table 1.1. Design Types and Their Objectives

Design Type	Model Objective
Two-level Screening	Identify factors of greatest impact on response
Response Surface	Model curvature effects
Mixture	Model effects that are components of a blend
Mixed Level	Model with two- and three-level, mixed quantitative and qualitative factors
Optimal	Model with D- and A-optimal designs for irregular design regions
Split-Plot	Model effects where some levels are hard to change
General Factorial	Model with full factorial designs and factors with several levels

Getting Started with a Simple Example

The best way to learn the ADX Interface is to step through a simple example. This example creates a fractional factorial design and illustrates a few of the plots you can use to explore the data.

Experimental Objective

Suppose you are doing a pilot study to examine five strains of bacteria (X1–X5) and determine which, if any, might be worth further study for use in dairy products. Since the eventual goal is to minimize the pH of milk in which these bacteria are placed, a screening experiment will be used to identify the strains that influence the pH.

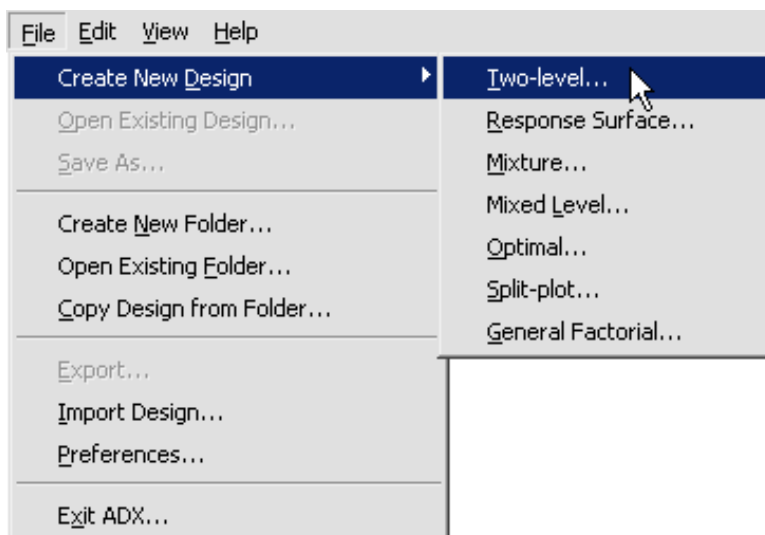
The factors in this experiment are the five strains (X1–X5). In each run of the experiment, a factor can have a coded value of -1 (strain absent) or $+1$ (strain present). The response variable is pH.

Task List

- Create a two-level factorial design.
- Type the response values into the design.
- Examine main effects plots and cube plots to see which bacterial strains are worth further investigation.

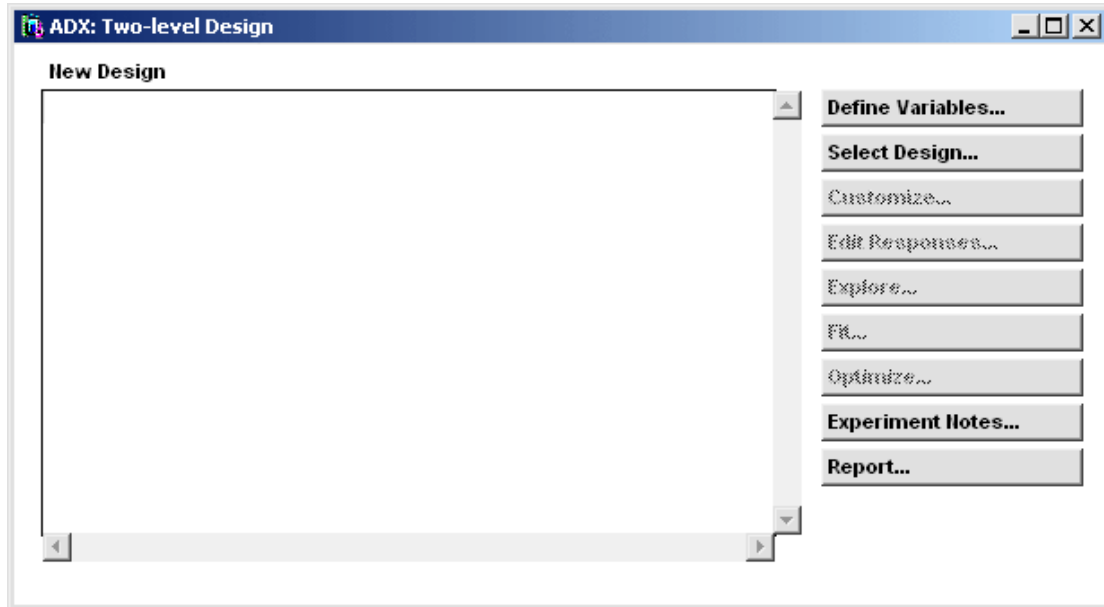
Creating the Design

Select **File** → **Create New Design** → **Two-level**.



Alternatively, you can click the **Two-level design** icon  on the toolbar.

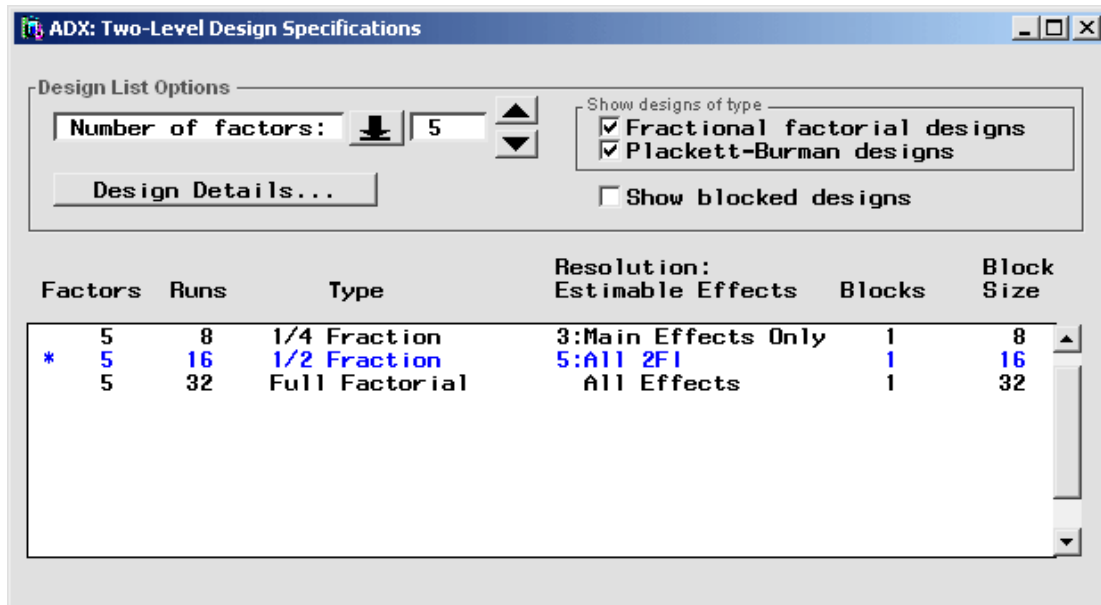
ADX brings up the main design window, which is titled Two-level Design.




The main design window is conveniently arranged to facilitate designing and analyzing an experiment. The task buttons are listed to the right of the design display area. The area on the left is blank until you select a design. (Some of the task buttons are grayed out until preliminary steps are completed.)

To create the design for the strains, follow these steps:

1. Click **Select Design** to open the Two-Level Design Specifications window.
2. Type **5**, the number of strains, for **Number of factors**:
3. Select the **1/2 Fraction** design, a 16-run Resolution 5 design.



- Close the window (select **File** → **Close** or click the upper right ) to use the design.

The Message window gives you a chance to change your mind.



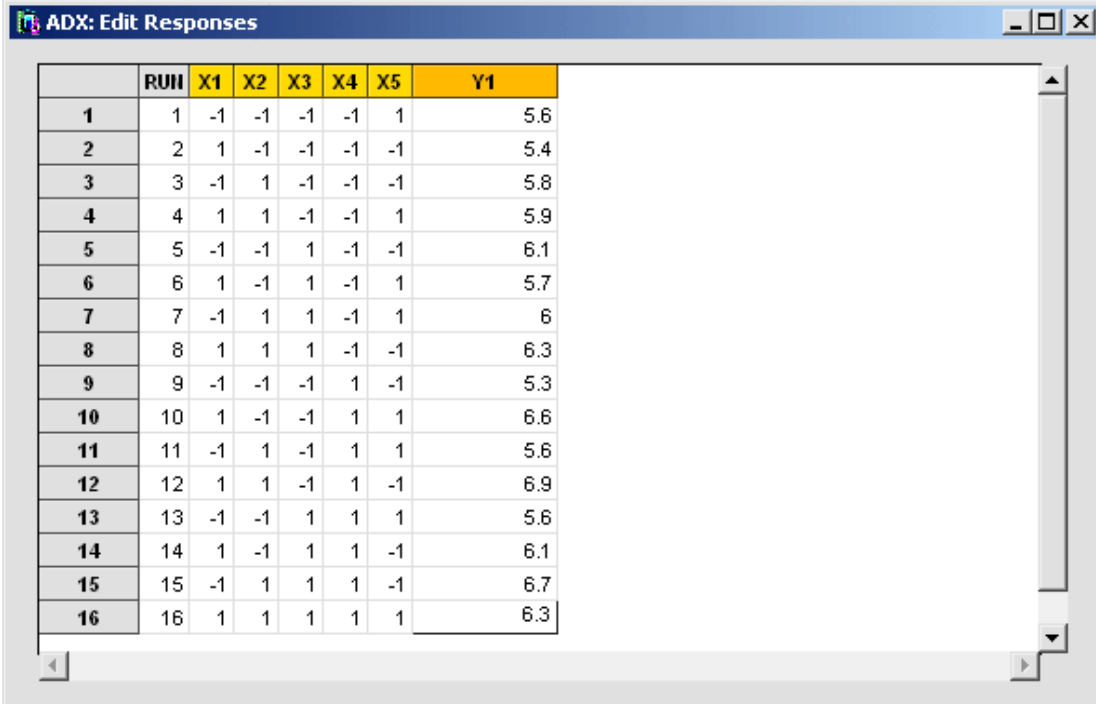
Click **Yes** to use the selected design. ADX returns to the main design window and displays a table of the runs in the design.

	X1	X2	X3	X4	X5
1	-1	-1	-1	-1	1
2	1	-1	-1	-1	-1
3	-1	1	-1	-1	-1
4	1	1	-1	-1	1
5	-1	-1	1	-1	-1
6	1	-1	1	-1	1
7	-1	1	1	-1	1
8	1	1	1	-1	-1
9	-1	-1	-1	1	-1
10	1	-1	-1	1	1
11	-1	1	-1	1	1
12	1	1	-1	1	-1

Default factor names are given at the top of the columns, and the levels of each factor are the rows. For the purposes of this experiment, X1 corresponds to the presence or absence of bacterial strain 1, X2 to strain 2, and so on.

To enter the response data into the design, follow these steps:

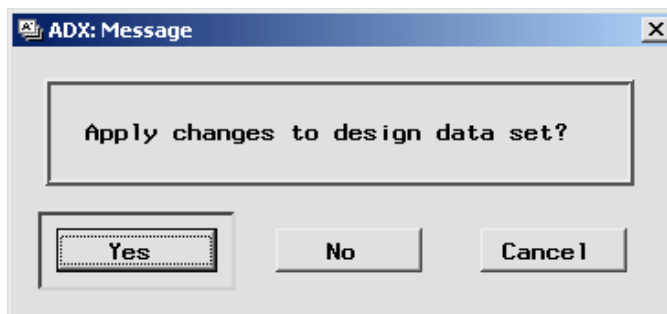
1. Click **Edit Responses**. ADX takes you to the Edit Responses window and provides a column, called **Y1**, for you to enter the pH response values.
2. Type the following pH values in the default response column **Y1** (in order from row 1 to 16): 5.6, 5.4, 5.8, 5.9, 6.1, 5.7, 6, 6.3, 5.3, 6.6, 5.6, 6.9, 5.6, 6.1, 6.7, 6.3.



The screenshot shows a window titled "ADX: Edit Responses" containing a table with 16 rows and 7 columns. The columns are labeled "RUII", "X1", "X2", "X3", "X4", "X5", and "Y1". The rows contain numerical values for each column, with the "Y1" column showing a range of values from 5.3 to 6.7.

	RUII	X1	X2	X3	X4	X5	Y1
1	1	-1	-1	-1	-1	1	5.6
2	2	1	-1	-1	-1	-1	5.4
3	3	-1	1	-1	-1	-1	5.8
4	4	1	1	-1	-1	1	5.9
5	5	-1	-1	1	-1	-1	6.1
6	6	1	-1	1	-1	1	5.7
7	7	-1	1	1	-1	1	6
8	8	1	1	1	-1	-1	6.3
9	9	-1	-1	-1	1	-1	5.3
10	10	1	-1	-1	1	1	6.6
11	11	-1	1	-1	1	1	5.6
12	12	1	1	-1	1	-1	6.9
13	13	-1	-1	1	1	1	5.6
14	14	1	-1	1	1	-1	6.1
15	15	-1	1	1	1	-1	6.7
16	16	1	1	1	1	1	6.3

3. Close the window.
4. Click **Yes** to accept the changes. ADX will return you to the main design window and show the new response values.

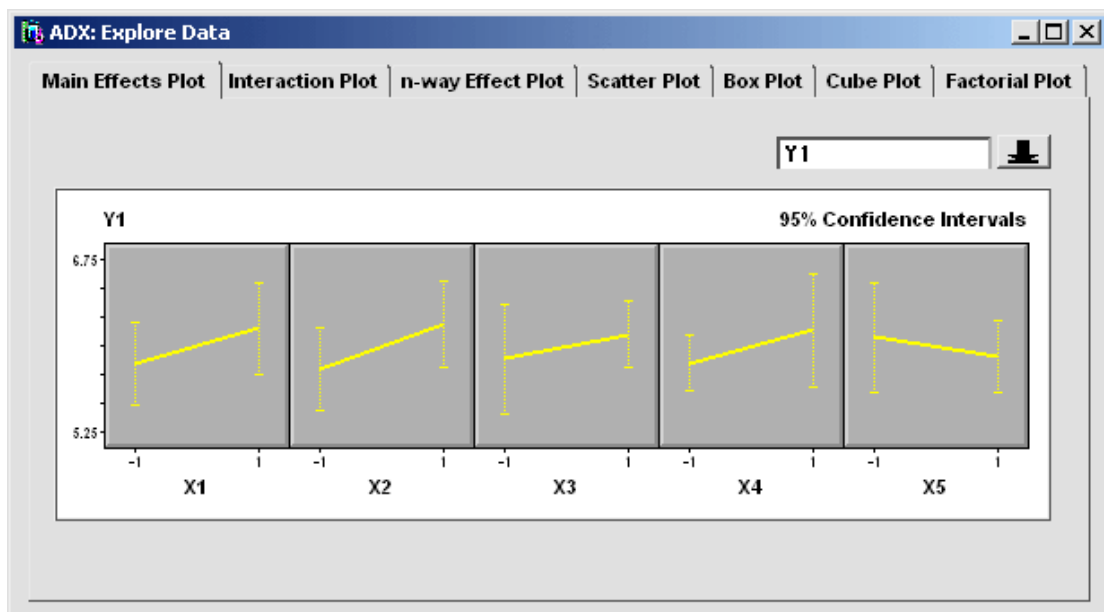


Once a design has response values, you can use the **Explore**, **Fit**, and **Optimize** features for exploring and analyzing the data. However, you cannot select a different design.

Exploring Results

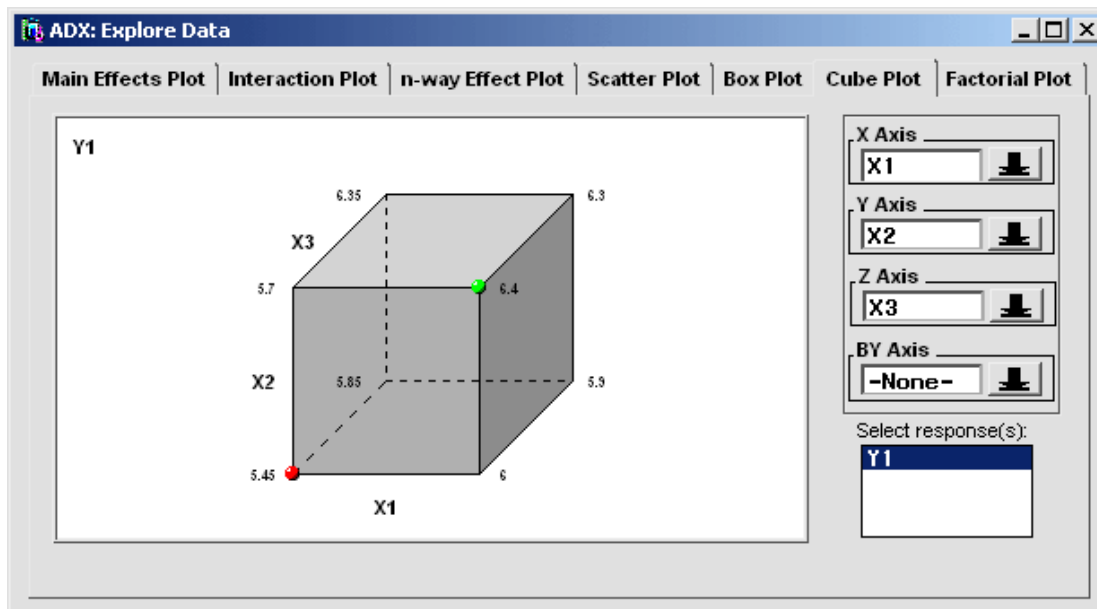
To view the main effects and interaction plots, click **Explore**. The Explore Data window will open.

In a main effects plot, the slope of the line connecting the low level to the high level indicates the strength of the effect or, in this case, the ability of the strain to change the response, pH.




Switch to the cube plot by clicking the **Cube Plot** tab.

The cube plot, like all the graphics displays in ADX, is interactive. For example, place the mouse cursor over the X1 label. The cursor changes to a hand to indicate that you can click and drag the label to another edge of the cube. You will learn about other interactive features in later chapters.

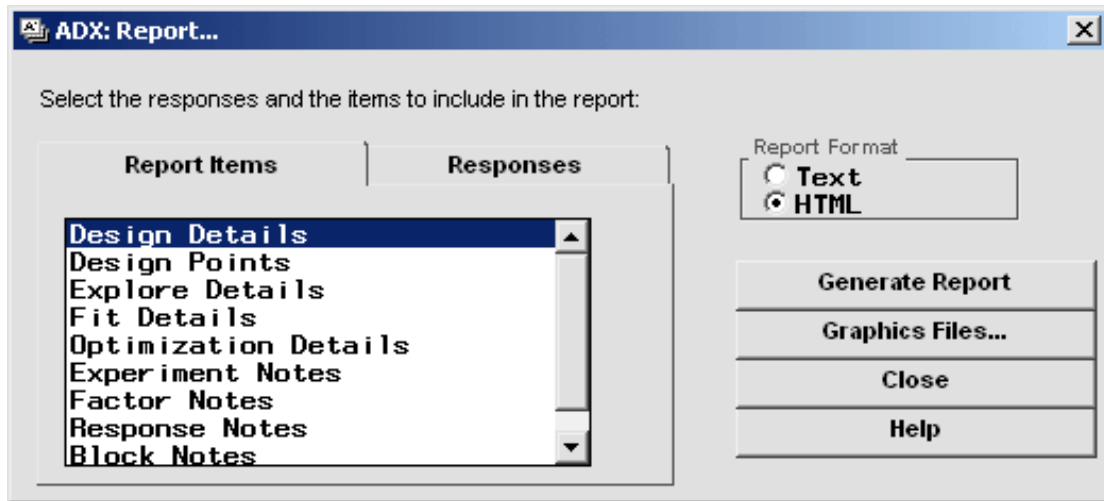


The values at the corners are averages of the response over all runs where the labeled factors in the plot are at the given value. For example, in this plot the average value of Y1 over all runs where strains X1, X2, and X3 are absent is 6.3. The symbols at certain corners indicate which combinations of levels give the highest and the lowest pH (Y1) values. The lowest average pH of 5.45 occurs when strains X1, X2, and X3 are present.

Select **File** → **Close** or click  to return to the main design window.

HTML Reports

To create a report on the results of the experiment, click **Report** on the main design window. ADX will present you with a window that enables you to customize your report.



Select the items and responses you wish to include in the report and click **Generate Report**. The following HTML report is displayed with Microsoft® Internet Explorer™.

Predictive Model for Y1

Coded Levels(-1,1)

$$Y1 = 5.99375 + 0.15625*X1 + 0.19375*X2 + 0.10625*X3 + 0.14375*X4 - 0.08125*X5 + 0.00625*X1*X2 - 0.15625*X1*X3 + 0.18125*X1*X4 + 0.05625*X1*X5 + 0.03125*X2*X3 + 0.04375*X2*X4 - 0.15625*X2*X5 - 0.06875*X3*X4 - 0.11875*X3*X5 - 0.03125*X4*X5$$

Uncoded Levels

$$Y1 = 5.99375 + 0.15625*X1 + 0.19375*X2 + 0.10625*X3 + 0.14375*X4 - 0.08125*X5 + 0.00625*X1*X2 - 0.15625*X1*X3 + 0.18125*X1*X4 + 0.05625*X1*X5 + 0.03125*X2*X3 + 0.04375*X2*X4 - 0.15625*X2*X5 - 0.06875*X3*X4 - 0.11875*X3*X5 - 0.03125*X4*X5$$


Effects for Y1

Term	Master Model			Predictive Model		
	Estimate	Std Err	t Pr > t	Estimate	Std Err	t Pr > t
X1	0.3125	..	0.0001	0.3125	..	0.0001
X2	0.3875	..	0.0001	0.3875	..	0.0001
X3	0.2125	..	0.0001	0.2125	..	0.0001
X4	0.2875	..	0.0001	0.2875	..	0.0001
X5	-0.1625	..	0.0001	-0.1625	..	0.0001
X1*X2	0.0125	..	0.0001	0.0125	..	0.0001
X1*X3	-0.3125	..	0.0001	-0.3125	..	0.0001

Text Reports

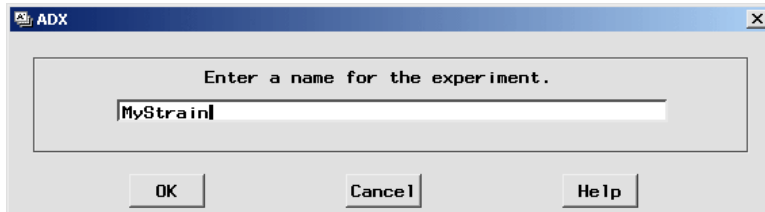
Clicking the **Text** radio button in the Report window generates a text-only report that you can edit. To save the text file, select **File** → **Save as** and select **Write to file** or **Write to object**.

Exiting ADX

When you are finished working with a design, select **File** → **Close** or click  from the main design window. A Message window appears to ask if you want to save the changes to the design permanently.

To save your design with the response values entered, follow these steps:

1. Click **Yes**.



2. Type **MYStrain** as the name for this design.
3. Click **OK**.

ADX adds the new My Strain design to the open desktop folder so you can use it later.

To exit ADX, follow these steps:

1. Return to the ADX desktop.
2. Select **File** → **Exit ADX** or close the desktop window.
3. A confirmation window appears. Click **OK**.

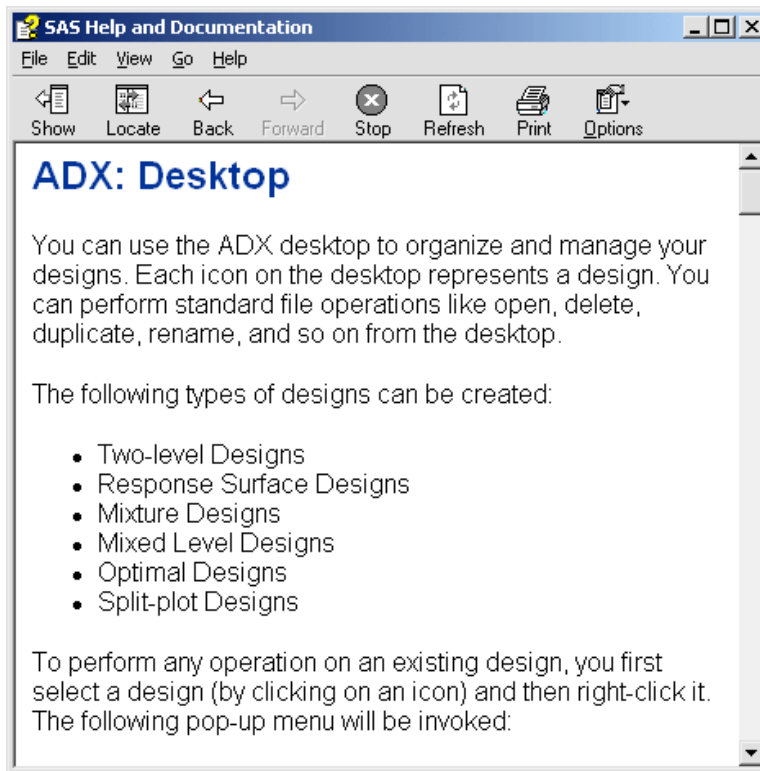



4. To exit the SAS System, select **File** → **Exit**.

Congratulations! You have just analyzed your first experiment using the ADX Interface.

Using ADX Help

ADX Help provides information on how to use ADX and on how to design experiments. Select **Help** → **ADX Help** to open the Help window.



Select **File** → **Close** or click  to close the Help window.

Points to Remember

- ADX has features for creating and analyzing experimental designs through a simple point-and-click interface.
- ADX is organized by type of experimental design.
- Different designs accomplish different types of experimental objectives.
- ADX uses folders to group designs so that you can organize designs according to projects.

- ADXPARM is the name for the default desktop folder that contains designs. By default, sample designs that accompany this book are placed in the ADXBK9 folder.
- The main design window contains all the commands you need to refine, edit, explore, and analyze your experiment. They are arranged from top to bottom in the order that you should follow.
- Click **Explore** in the main design window to show plots such as the main effects and cube plots.
- The online ADX Help system provides useful information on experimental design and analysis methods, and it explains how to implement them in the ADX interface.